

***Richmond Regional Impervious
Surface Inventory***

Phase III

November 16, 2009

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Richmond Regional Planning District Commission

Planning district commissions make government more efficient and effective through coordinated planning and program analysis. Virginia's General Assembly created planning districts in 1968 under the authority of the *Virginia Area Development Act*- revised as the *Regional Cooperation Act* in 1995- "to promote orderly and efficient development of the physical, social and economic elements of the districts." Through planning district commissions, now 21 in number, local governments solve mutual problems which cross boundary lines and obtain expertise from professional staff and advice on making the most of scarce taxpayer dollars through intergovernmental cooperation.

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Phase III

Mapping 2007 Impervious Surface of the Richmond Region

Introduction

The Richmond Regional Planning District Commission continued to study impervious surface area at the regional level for the FY09 Coastal Grant project funded by the National Oceanic and Atmospheric Administration (NOAA) through the Virginia Coastal Zone Management Program (VACZM). This document details Phase III of the impervious surface mapping project. Phase III complements and extends the analysis completed under Phase I and Phase II in FY05 and FY06 respectively.

For the purposes of this study, impervious surfaces include roads, parking lots, building footprints, and other impermeable surfaces usually associated with urban and suburban development. An increase in impervious area affects, among other things, the hydrologic cycle and as a result, water resources. Such effects may include: increased flooding and stream bank erosion, degraded aquatic habitat, reduced groundwater recharge, additional pollutants entering a river or other body of water from stormwater runoff, and reduction in healthy water supply.

Background

Phase I

Phase I began with the intent to measure the change in impervious surfaces in the Richmond Region between 1994 and 2002. The imagery used for the 1994 baseline came from the United States Geological Survey (USGS) color infrared Digital Orthophotography Quarter Quads (DOQQs). The 2002 imagery was a high resolution orthophotography product developed by Virginia Geographic Information Network (VGIN) under the Virginia Base Mapping Program (VBMP). The comparison of the digitized data from these years was the basis for measuring the change.

The digitization of impervious surface polygons on the 1994 and 2002 VBMP orthophotography was conducted using the Geographic Information Systems (GIS) software known as ArcGIS. When available, staff started with locality-generated information such as building permits and existing GIS data layers. A database was established for the impervious surface features. For localities with a building footprint layer, existing data was used as a starting point. In some

cases, localities had not prepared an existing building footprint layer, so a layer was created by digitizing structures visible in the orthophotography. Information about the newly digitized polygons was placed into the database attribute table. The polygons were classified as either in 1994 orthoimagery or constructed between 1994 and 2002.

In comparison, there were degrees of inaccuracy between the 1994 and the 2002 polygon delineations due to resolution quality of the two orthophotographic sources and differences in the data projections. The color aerial photography used to capture the 2002 data provided the user more detailed and accurate imagery than was possible when using the 1994 color infrared DOQQs. Using the road and structure polygons, the impervious area was calculated for both 1994 and 2002. Maps were prepared as a visual tool illustrating the change in regional impervious surface.

For a more detailed methodology of Phase I, please refer to Mapping Impervious Surface in the Richmond Region with Ortho Imagery section in the *Impervious Surface in the Richmond Region* report that can be found at www.richmondregional.org.

Phase II

Phase II of the project was conducted between January and September 2006. The goal of Phase II was to improve the accuracy of the existing building polygons, capture driveways, improve classification of polygons by using a standard classification system in the four rural jurisdictions, and improve the road layer, region-wide, to reflect the difference in road widths between rural and urban/suburban jurisdictions. It was decided that a similar analysis using 1994 orthophotography would be less valuable due to the lower resolution and quality of the DOQQs.

A final step was to identify inconsistencies due to varying techniques of individual technicians compiling the project. Separate technicians analyzed and coded impervious areas differently in Phase I which resulted in polygons having different configurations and impervious use codes. Methodology was reassessed and use codes were corrected to reflect a comparable category and a more generalized use code. Use codes included, but were not limited to, buildings (residential, commercial and industrial), airports, driveways, parking lots, pools, and tennis courts.

The refinement of the Phase I methodology resulted in very similar calculations at the regional level, but greatly differing calculations at the county/city level. Discussions of the results for each jurisdiction were also included. The Phase II report, *Refining Impervious Surface in the Richmond Region*, is available at www.richmondregional.org.

Process

Phase III

Phase III of the project was conducted between November 2008 and September 2009. The goal of Phase III was to digitize impervious surface for an additional year so as to expand the data

catalogue of Richmond Region impervious surface data to use for analysis. During Phase III, technicians digitized building footprints erected between 2002 and 2007. The base for this project was leaf-off imagery, gathered in 2007, as high resolution orthophotography and developed by VGIN as part of the VBMP. The analysis presented in this report reflects the addition of impervious area of building footprints to total impervious surface area gathered under Phase I and II; specifically, studies the change in impervious surface that occurred between 2002 and 2007. Figure 1 is an image of a working screen of the development of impervious surface data digitized for this project. In it one can see the progression of development digitized from the 1994, 2002 and 2007 aerial photography.

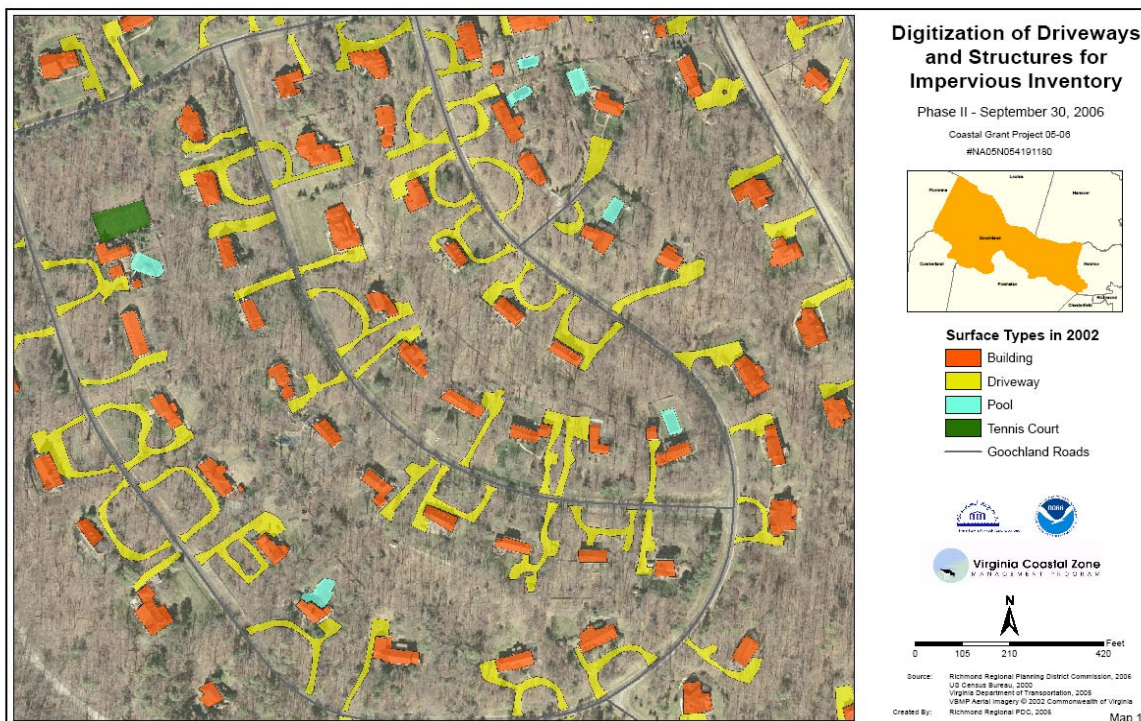


Figure 1: Example of data layers and attribute table for polygons

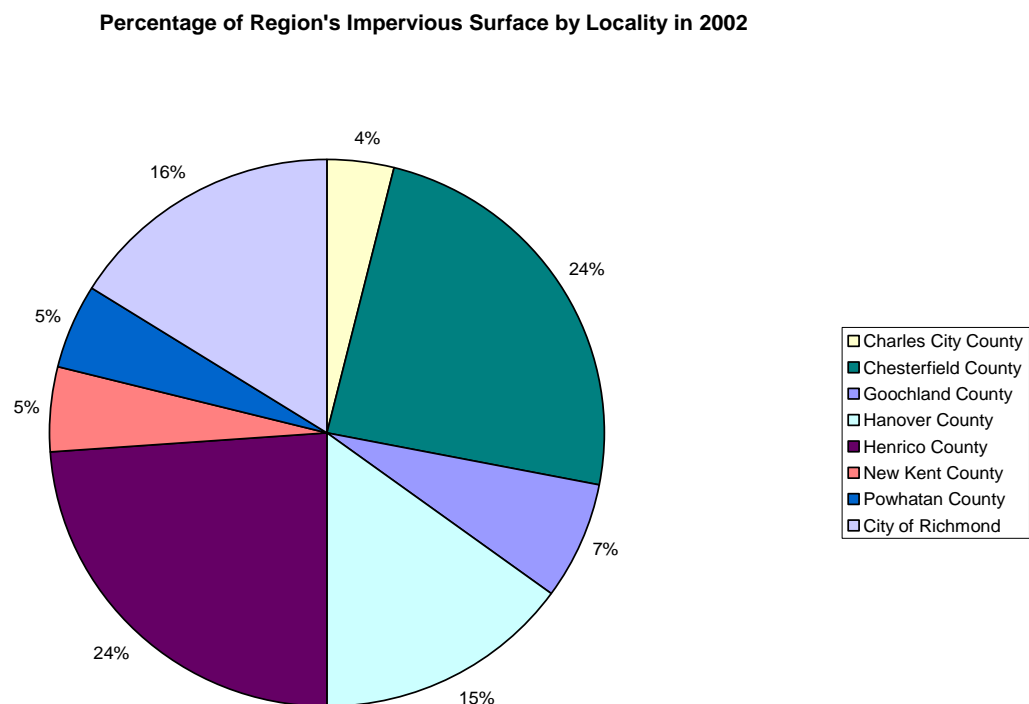
Structures

A progress grid was created using the GIS software and was overlaid on the 2007 digital orthophotography. The progress grid allowed technicians to scan the digital orthophotography in a systematic manner so that all parts of the region would be included in the digitized building footprint data set.

Results

In 2002, Henrico County had the greatest area of impervious surface in the region with 19,200 acres (12.20 percent of the county, 24 percent of the total region). Chesterfield County (18,560 acres of the county, 24 percent of the region), the City of Richmond (12,800 acres of the city and 16 percent of the region), and Hanover County (11,520 acres of the county, 15 percent of the region) all had a larger area of impervious surface than New Kent County (3,840 acres of the county, five percent of the region), Powhatan County (3,840 acres of the county, five percent of the region), Goochland County (5,760 acres of the county, seven square miles of the region), and Charles City County (3,200 acres of the county, four square miles of the region). (See Chart 1)

Chart 1: Percentage of Region's Impervious Surface by Locality in 2002



Results of the research for the 2007 impervious surface are summarized below. It should be noted that these results are preliminary. For Phase IV of this project, the RRPDC staff will incorporate additional impervious area from the 2007 ortho-photography images including pools, tennis courts, parking lots, driveways, and roadways. The RRPDC is also considering applying *Feature Analyst* software to improve the detail of impervious area captured in 1994, 2002, and 2007.

Information from impervious area captured for 2007 thus far indicates the following:
In 2007, there was a total of 2 percent, or 32,229 acres of impervious surface of buildings in the Richmond region.

Between 2002 and 2007, the area of impervious surface of buildings made the total impervious area grow by 7 percent in the region.

Data for buildings was collected for 2007 for eight localities in the Richmond region. Of these localities, the City of Richmond had the highest percentage of total impervious surface in 2007 (49%), but the lowest relative increase in impervious surface over the five years (1%).

Compared to the other rural localities, Charles City (18%) had the largest increase in impervious surface between 2002 and 2007. The three other rural counties of New Kent (17%), Powhatan (14%), and Goochland (13%) had similar relative increases in impervious surface over the five years between 2002 and 2007.

The data indicated that the suburban counties of Chesterfield (9%), Henrico (8%), and Hanover (7%) had less percent increase but a greater amount of impervious area than most of the rural counties. (see Chart 2)

Chart 2: Percentage of Region's Impervious Surface by Locality in 2007

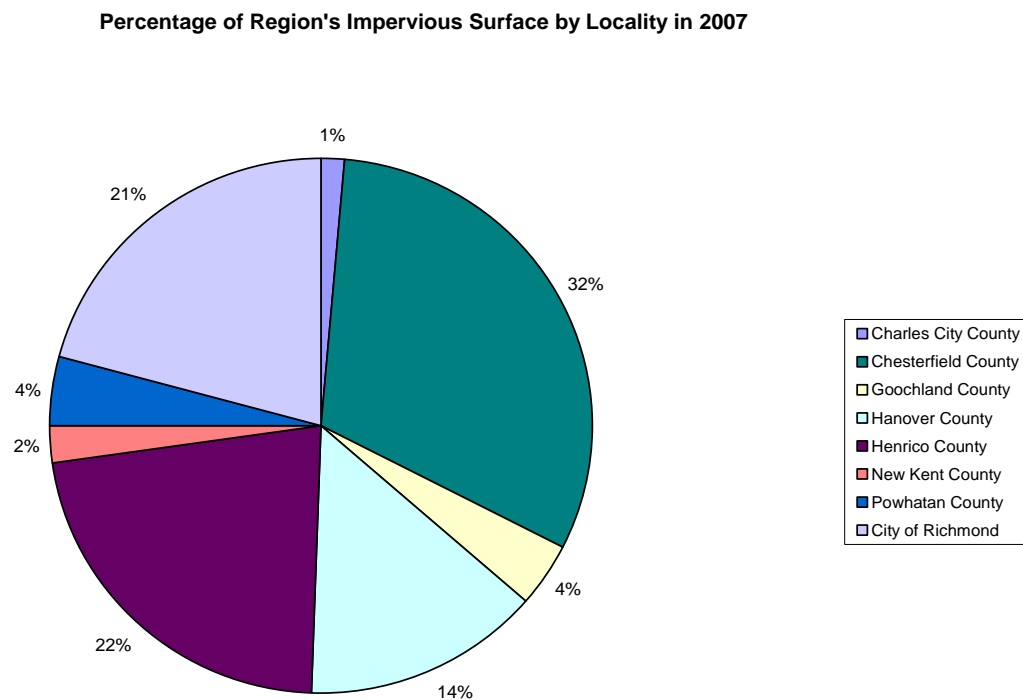
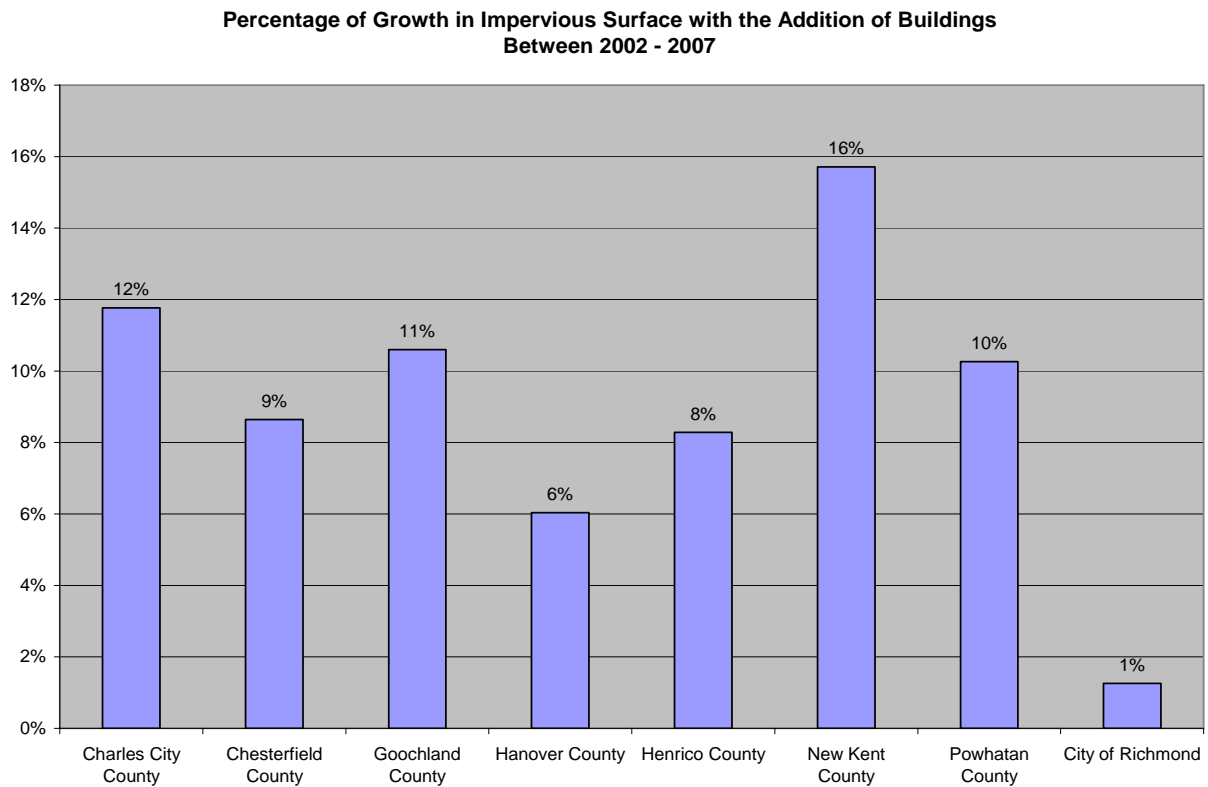


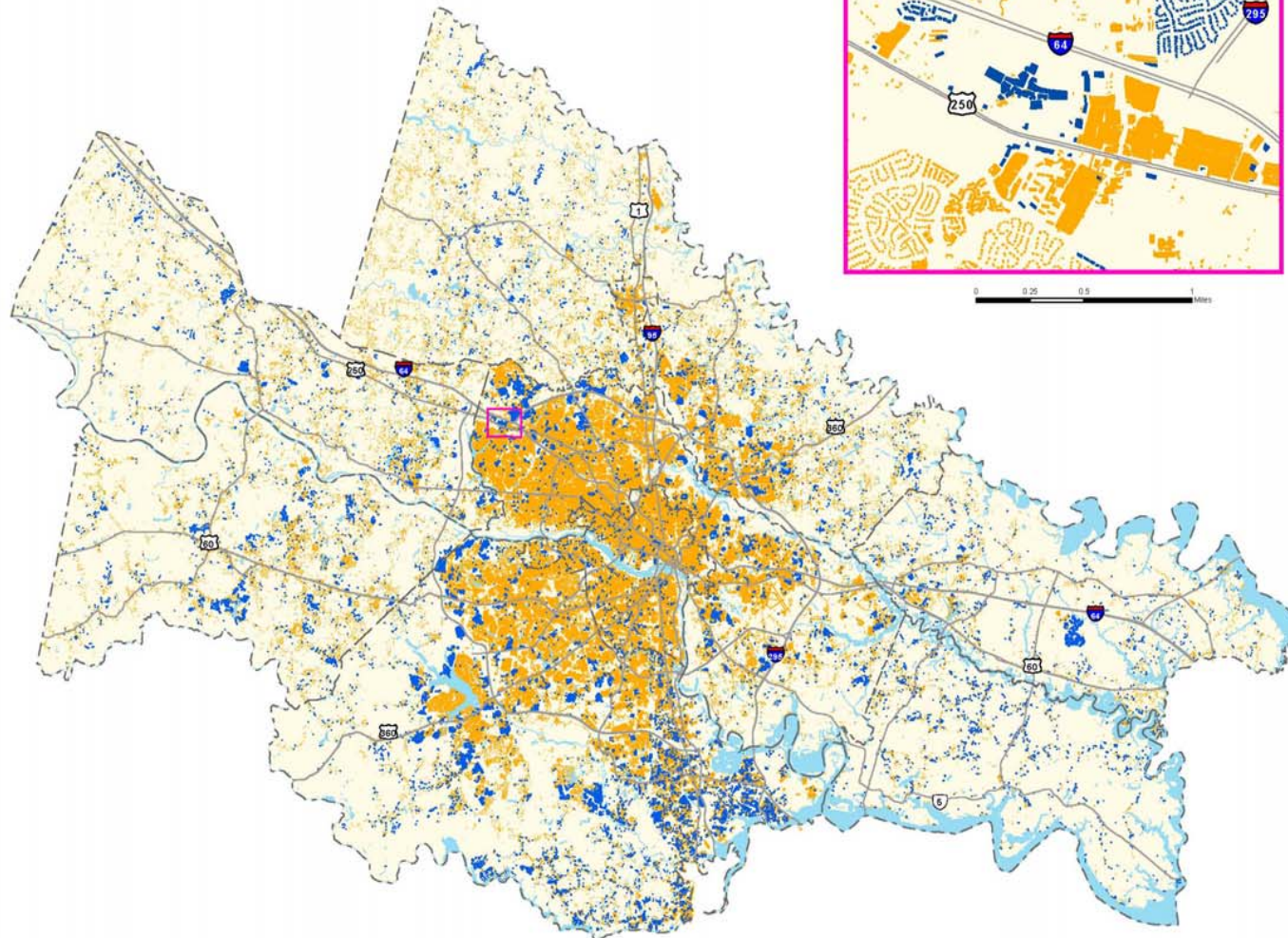
Chart 3 shows the percentage of growth between total impervious coverage in 2002 and the addition of impervious area of buildings for each of the eight localities for which data was collected in both 2002 and 2007.

**Chart 3: Percentage of Additional Growth in Impervious Surface of Buildings
Between 2002 - 2007**



A map of the region is attached. This regional perspective shows impervious area for structures erected prior to 2002 and impervious area for structures erected between 2002-2007. (See Map 1)

Richmond Region

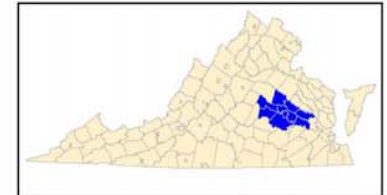


Impervious Inventory of Structures 2002 & 2007

Phase III - October, 2009

Coastal Grant Project 08-09

#NA08NO54190466



- 2003-2007 Impervious Inventory Structures
- Up to 2002 Impervious Inventory Structures
- River/Lake
- Road



**Virginia Coastal Zone
MANAGEMENT PROGRAM**



0 1 2 4 6 8 10 12 Miles

Prepared by: Richmond Regional PDC, October 2009

Source: City of Richmond
County of Henrico
County of Chesterfield
County of Hanover
Richmond Regional PDC
US Census Bureau
Virginia Department of Transportation
Commonwealth of Virginia VBMP
Aerial Imagery © 2002 -2007

Due to the scale of these maps it is difficult to distinguish that all the structure are polygons. The structures consist of residential and commercial buildings.